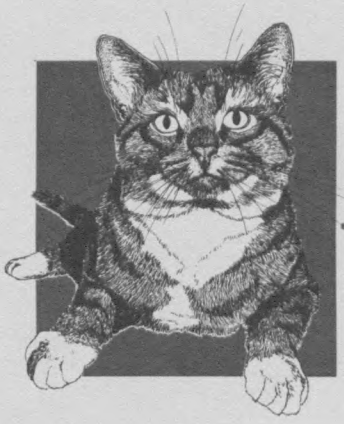


Cornell Feline Health Center
Veterinary News
Winter 1983

Campylobacter jejuni and *Cryptosporidia:* Two New Causes of Feline Diarrhea

Sandy Baldwin, D.V.M., M.S.

There are many causes of diarrhea in cats, and this article purposes to alert the practitioner to two newcomers on the disease front. One is a bacterial infection, Campylobactor jejuni; the other is a protozoan disease, Cryptosporidiosis. Both can be extremely difficult to diagnose. Neither disease is particularly life-threatening as far as adult cats are concerned, but in the young kitten both are potential problems. This is primarily a result of the dehydration that follows the severe watery diarrhea, a problem more likely to be associated with C. jejuni than perhaps would be seen with Cryptosporidiosis. Since both are relatively "new" diseases, little is known about either, especially in the feline.

Campylobacter jejuni

C. jejuni, a small gram (-) rod, is morphologically similar yet antigenically distinct from C. fetus (Vibrio fetus). In most species of animals, including the cat, dog, and man, the signs seen include fever, chills, nausea, watery diarrhea with or without blood, and vomiting. In addition, signs in man have also included abdominal cramps and myalgias. These signs are not specific for C. jejuni and could be seen with almost any cause of gastrointestinal disease in the cat, including E. coli, panleukopenia, rotavirus, and endoparasites. Disease is more common in kittens than in adults. Fortunately, with specific therapy, C. jejuni infection can be completely cured.

Diagnosis is difficult, however. One must specifically look for and culture for C. jejuni because, as with all other Campylobacters, it has very specific requirements for growth. The organism requires microaerophilic conditions (5% oxygen, 10% carbon dioxide) for growth, and it may require up to one week of incubation before colonies will be seen. In addition, the bacteria will not persist very long in clinical specimens. Many false negatives may result if proper techniques for sampling and culturing are not followed. Finally, use of selective broths before the use of selective enrichment media may be necessary for a successful culture of C. jejuni. If direct smears are attempted, it is doubtful that the organism will be visualized. C. jejuni is a very small, curved rod and is at the approximate limits of resolution for the light microscope. But if the bacteria are found and a sensitivity test is performed, curative antibiotics can be used. In man, erythromycin has produced very good results, but many other antibiotics have proven to be just as efficacious.

Treatment of watery diarrhea is in general nonspecific and consists primarily of fluids, administered either intravenously or subcutaneously as determined by the degree of dehydration. The use of antidiarrheals should be limited to only those cases where secondary intussusception is likely. If needed the antidiarrheal of choice would be Pepto-Bismol. Antibiotics should only be used in specific disease instances, and Campylobacter appears to be such a case. The indiscriminate use of antibiotics can have a profound effect on the local microflora

and can be very detrimental to the kitten, leading to prolongation of clinical disease and/or increasing severity of symptoms.

Two major problems exist with Campylobacter infection. One is the apparent high number of clinically normal animals, including cats and dogs, that harbor C. jejuni. Studies for carrier cats have shown an incidence of 4-10% in the population, up to a high of 45% in one study performed in England. In dogs, much the same picture emerges; carrier animals have been found to be anywhere from 5% to 50% of the population. Sheep are also known to harbor the organism. But before these pets receive all the blame, it must be remembered that processed poultry products have also shown a large number of positive isolations for Campylobacter sp.

Herein lies the second problem associated with infection in the domestic animals: namely, the existence of the disease in man. There are many cases reported in which human owners, particularly children, have become infected with the same biotype found in the pet. In some cases, the pet had not shown any signs of disease. Practitioners must remember this possible cause of infection if presented with kittens showing persistent diarrhea unresponsive to the usual therapy methods and uncultivable with the usual bacteriological techniques, especially if the owners begin to show symptoms. Unfortunately, with the large number of normal carriers, Campylobacter cannot be definitively incriminated as the cause of disease.

Cryptosporidiosis

Cryptosporidia are very small coccidial parasites that recently have been shown to be a possible cause of diarrhea in young calves and lambs. Studies at the Cornell Feline Health Center have also uncovered Cryptosporidia as a possible cause of diarrhea in a Specific Pathogen Free colony of cats. More work needs to be done to delineate the exact role of these parasites in the diarrhea complex. In the other species in which Cryptosporidia have been described, including calves, lambs, foals, goats, parrots, and man (including a veterinary student in contact with a Cryptosporidial-infected calf), clinical disease or morphological lesions were found in the intestine. (In addition, respiratory Cryptosporidia have been described in the turkey.)

Morphological changes have included villous atrophy and marked alteration of glandular structures of the jejunum with Cryptosporidial forms seen in the striated border of the villus epithelial cell.

Again, as in Campylobacter, the problem is one of diagnosis. Cryptosporidia are about 3-4 u long. When compared to the 30 u long Isospora (common coccidia), it can be seen that they are very difficult to visualize. As in the case of Campylobacter, the Cryptosporidial organism is just at the resolution limits of a good light microscope, and only careful screening under oil immersion will be successful.

Once the disease is diagnosed, treatment is straightforward. The usual coccidiostats should have some benefit, at least as a preventative. It has been suggested that 1:10,000 dilution of Amprolene®, a chicken coccidiostat, in the drinking water may be beneficial for treatment of coccidia. It must be remembered, however, that Amprolene® has not been approved for cats. The public health significance is unknown but, as mentioned, one student did have contact with infected calves and did contract disease. It is unknown if Cryptosporidia are species-specific, as most of the remaining coccidia are.

In summary, it is hoped that these clues for diagnosis prove valuable to veterinarians confronted with kittens who have chronic unresponsive diarrhea, particularly if the owners also begin to show signs of disease.

Charles A. "Sandy" Baldwin (Cornell '73; M.S., Cornell '82) is working toward his Ph.D. in Veterinary Virology, specializing in feline enteric diseases.

A Message From The Director

Fredric W. Scott, D.V.M., Ph.D.

As we head into 1983, I'd like to wish each and every one of you a joyous and prosperous New Year! May the Lord be gracious to you.

Dr. Leo Wuori Retires

As of January 1, 1983, Dr. Leo A. Wuori retired as Assistant Director of the Cornell Feline Health Center. After 38 years in private practice and two years with the CFHC, he has more than earned the privilege of spending some additional time in warmer climates than Ithaca, extra time on the golf course, and doing those things a busy veterinarian just never quite gets time to do. We all wish him well.

It is our good fortune that we will not be losing Dr. Wuori's talents and experience entirely. He has graciously agreed to continue serving the CFHC as a "Special Consultant," especially as a liaison to the veterinary profession and Cornell alumni. Undoubtedly you will be hearing from him from time to time.

I would like to take this opportunity to thank Dr. Wuori for his valuable contributions to the CFHC over the past two years. It has been a critical period of growth for the CFHC. His efforts have been vital in our reorganization and expansion to get the Feline Center moving toward the active, responsive research center we all knew it could be.

CFHC Staff Reorganized

Dr. Wuori's retirement necessitated a restructuring of our office staff. Mrs. Edna Federer has been promoted to the position of Assistant Director for Public Affairs. She is responsible for the day-to-day operations of the office, fund raising, publications, continuing education, and coordinating the activities of an external volunteer organization currently being formed. Her advancement from Secretary to Administrative Aide to Assistant Director reflects her outstanding abilities and total dedication to the Feline Center and its goals.

Mrs. Joyce Tumbelston, Assistant Editor for the past two years, now assumes the duties of Editor. A very talented individual, Joyce has done an extraordinary job with our publications, given the limited help and resources available to her. Our publications and communications with practicing veterinarians and cat owners are the lifeblood of the CFHC; without them, public support for all of our activities, including scientific and research endeavors, would wither and die.

Miss Sheryl Bronger, who started as a volunteer this past summer, is now serving admirably in the position of Secretary.

I personally am blessed to have such a talented, dedicated, and pleasant staff. With a staff like this, you can be assured that your Feline Center is in good hands.

Our New Look

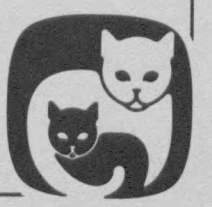
Those who have been receiving our newsletter for some time will notice this issue has a new look, a new logo, and a new name. We feel these changes make the publication much more attractive, and also emphasize the distinction between this and our newsletter for cat fanciers. We hope you appreciate these changes, as we strive toward excellence in every way.

Cornell Feline Health Center
Veterinary News

A publication for veterinary professionals

The ultimate purpose of the Cornell Feline Health Center is to improve the health of cats everywhere, by developing methods to prevent or cure feline diseases, and by providing continuing education to veterinarians and cat owners. All contributions are tax-deductible.

Director: **Fredric W. Scott, D.V.M., Ph.D.**
Asst. Director-Public Affairs: **Edna H. Federer**
Editor: **Joyce Tumbelston**
Secretary: **Sheryl A. Bronger**
Special Consultant: **Leo A. Wuori, D.V.M.**



Inherited Craniofacial Malformations of Burmese Cats

Drew Noden, Ph.D.; Alexander de Lahunta, D.V.M., Ph.D.; Howard E. Evans, Ph.D.

In 1979 five Burmese kittens were received at the New York State College of Veterinary Medicine for examination of head malformations. These came from three different breeders located in the eastern part of the country. This year, through the efforts of the Burmese Cooperative Research Project, six more affected kittens plus normal littermates have been received and examined.

Gross examination reveals cerebral exencephaly (encephalocele), in which the forebrain protrudes through an opening in the front of the skull (cranioschisis) at the level of the frontoparietal suture. The frontal and nasal regions are greatly reduced, which results in the integument in this area being abnormally folded. The eyelids and palpebral fissure, if present, are obscured by this folding. No external nares are visible, and there appear to be two pairs of whisker pads circumscribing the upper jaw. In some cases the roof of the mouth is of normal length but is curved upward. This is a secondary result of the shortening of the upper jaw, a condition called superior brachygnatha.

Gross neuroanatomical examination reveals that the lateral ventricles, which are cavities located within the cerebral hemispheres, are usually not dilated. This gives each half of the forebrain the

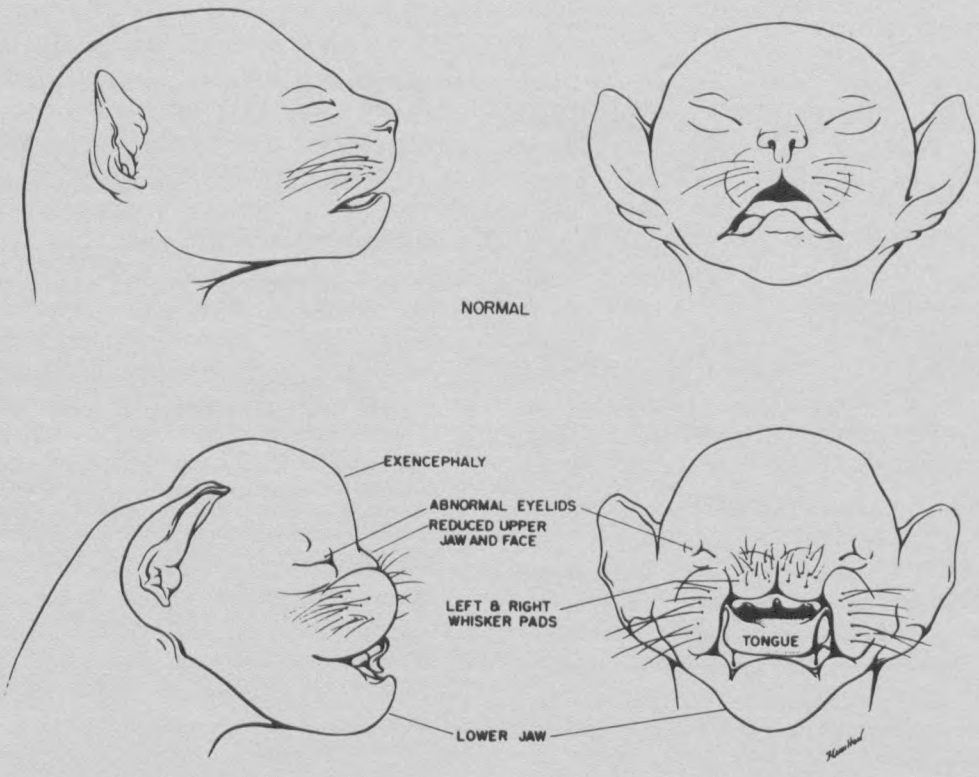


Fig. 1. Lateral and frontal views of normal (upper) and affected Burmese (lower) kittens.

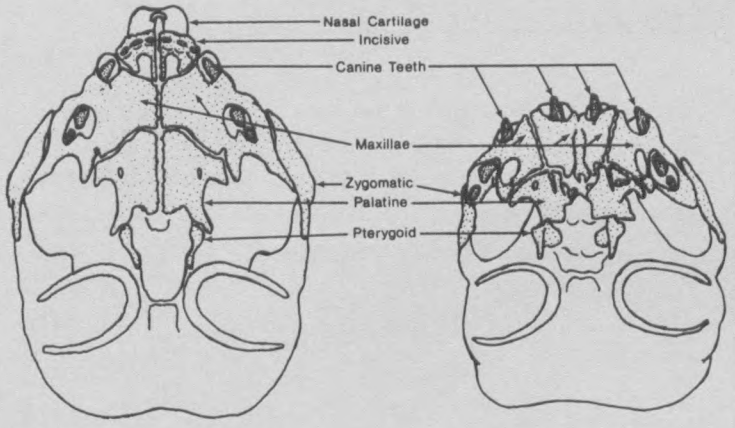


Fig. 2. Ventral view of the palatal area of normal (left) and affected Burmese kittens.

appearance of being a solid mass of neural tissue. The herniated neural tissue adheres tightly to the overlying skin, and in several cases there is a 2-4 mm dorsal defect in the skin that exposes the neural tissues. Small eyes lacking pigment are present in the reduced orbits. The rest of the nervous system is grossly normal.

To better appreciate the nature of the skeletal defect, several intact specimens have been treated with Alcian blue to stain cartilages and Alizarin red to stain bones. The material is then cleared and dehydrated to reveal the precise location of all skeletal tissues of the skull. Examination of affected Burmese kittens using this method has revealed a set of anomalies that were unexpected based upon the gross examination. Most apparent is the presence of two pairs of maxillary bones, which are the bones that form part of the upper jaw and roof of the mouth.

Normally, the left and right maxillae each develop a long ventral projection called the palatal shelf. Halfway through gestation, these shelves elevate to become horizontal and then fuse together to form the definitive palate. In the affected Burmese kittens all the preceding events have occurred normally, but in duplicate. Also, in the normal kitten each maxilla has a single large canine tooth, in front of which are incisor teeth located in the incisive (premaxillary) bones. In the affected Burmese kittens there are four canine teeth, one on each maxillary bone, but no incisor teeth or incisive bones. The nasal cartilages, nasal bones, ethmoid complex and vomer are also missing. Some of the remaining bones of the orbit are present but abnormally arranged.

Based on these observations it is clear that the Burmese condition is an example of incomplete cojoined twinning. Normally, the cells that form the maxillary bones arise in the dorsal midline of the embryo at the level of the midbrain and migrate ventrally around the caudal margin of each eye. Later this population of cells, called neural crest cells, grows rostrally beneath each eye and the forebrain, forms the maxilla and palatal shelf on each side of the head, and also participates in the development of the orbit and cheekbone (zygomatic arch). Many experimental studies have shown that neural crest cells cannot migrate and form these bones unless the primordium of the eye is present early in development. Thus, while only small fragments of optic tissue are found at birth, the precursors of the eyes must have been present earlier in development.

Based on analysis of newborn kittens it is not possible to explain the absence of the incisive, nasal and ethmoidal bones and cartilages. All of these are also usually derived from the neural crest, but from crest cells that arise in front of those involved in the formation of the maxillary bones. It is unlikely that these rostral neural crest cells failed to form, since other tissues having the same origin, in particular the forebrain and diencephalon, are present. Similarly, based on our finding of skeletal duplications, it is probable that each of the masses of neural tissue protruding through the opening in the skull are, in fact, fused pairs of cerebral hemispheres.

This malformation is unique in that, unlike most craniofacial anomalies, it is

Broadway's *CATS* to Benefit CFHC

The hottest new show on Broadway is a tribute to our favorite creatures - "CATS." In case you haven't heard, "CATS" is a delightful musical, featuring some very convincing feline impersonators singing, dancing and cavorting their way through episodes from "Old Possum's Book of Practical Cats," the poetry of T.S. Eliot. Time, Life, Newsweek, The New York Times, and numerous other major publications have recently festooned their pages with the zany antics of these exotic characters.

A benefit performance of "CATS" will be given at 8:00 p.m. on Saturday, March 5, 1983, at New York City's Winter Garden Theater, to benefit the Cornell Feline Health Center. Proceeds will be used for the endowment of a new service for veterinarians and cat owners alike, unrivaled by any other institution: the Dr. Louis J. Camuti Memorial Feline Consultation and Diagnostic Service.

A great friend and charter member of our Feline Advisory Council, Dr. Camuti was the nation's first exclusively feline practitioner. Early in his 60-year career he converted to a "house calls only" practice, which he continued for over 50 years in the greater New York City area. He served the rich, the famous, and the humble with equal dedication, and was dearly loved.

After his death in February 1981, Dr. Camuti's friends, family, and admirers chose to establish the consultation and diagnostic service in his memory. Once the necessary funds are obtained, a full-time feline specialist will be available for telephone consultation, new feline diagnostic systems can be developed, and standardized testing procedures will be supplied to laboratories throughout the country. Thus the memorial will continue and expand Dr. Camuti's tradition of exemplary service to cats and their owners.

A limited number of orchestra seats are available for the "Cats" benefit performance. The price of a memorable night out while making a worthy contribution to the advancement of feline medicine is $100. To get in on this extraordinary evening of fun entertainment, send your ticket request and check made payable to **"CATS"-Cornell Feline Health Center** to: Dr. Fredric W. Scott, Director; Cornell Feline Health Center; N.Y.S. College of Veterinary Medicine; Ithaca, NY 14853.

Burmese (continued)
inherited. The studies currently in progress are primarily aimed at understanding the malformation and its mode of inheritance in the Burmese cat, in the hope that this lethal condition can be removed from the breeding population. However, by carefully examining early embryonic stages in these affected kittens we may also significantly advance our understanding of the mechanisms that control normal craniofacial development in all mammals, including humans.

The authors gratefully acknowledge the Burmese Cooperative Research Project for their cooperation and support in these preliminary analyses.

Dr. Drew Noden completed his Ph.D. in Zoology at Washington University, St. Louis, Mo. in 1972. He has been an Associate Professor of Veterinary Anatomy at Cornell since 1979.

Dr. Alexander de Lahunta (D.V.M., Cornell '58; Ph.D., Cornell '63) is a Professor of Veterinary Anatomy at Cornell. He is also Chairman of the Department of Clinical Sciences and Director of the Veterinary Medical Teaching Hospital.

Dr. Howard E. Evans completed his Ph.D. in Comparative Anatomy at Cornell in 1950. A Professor of Veterinary Anatomy and Chairman of the Anatomy Department, he is also a Cornell Faculty Trustee.

Phototherapy of Cancer

John S. Clauss, D.V.M.

The treatment of neoplastic diseases is often one of the most difficult and frustrating aspects of veterinary medicine. Various cancerous conditions do not uniformly respond to present modes of cancer therapy and for this reason research is constantly searching for new, more effective methods of cancer treatment. A recent development of such research is phototherapy. The technique of phototherapy was developed at Roswell Park Memorial Institute in Buffalo, N.Y. in the mid-1970s and has recently been applied to clinical veterinary cancer patients by Dr. Richard Thoma at the Town and Country Animal Clinic, Cheektowaga, N.Y.

Phototherapy involves the use of a photoactivated drug which is selectively taken up and retained by malignant tissue but rapidly cleared from normal tissue. Upon subsequent illumination with ordinary red light, the drug within the malignant tissue is electronically excited and releases energy, causing oxidation of cell components and death of the cell. In this way the malignant tissue is destroyed while surrounding normal tissue is spared.

The drug used in phototherapy is known as hematoporphyrin derivative (HPD). HPD is produced by acetic acid-sulfuric acid treatment of crude hematoporphyrin derived from bovine hemoglobin. Following injection into the patient, HPD is distributed to all tissues but is rapidly cleared from normal tissues while retained at high levels within malignant tissues. HPD is also retained in high levels in the liver, kidney, and spleen. HPD is a relatively nontoxic drug, the only toxicity being a hypersensitivity to sunlight for several weeks following injection of the drug. For this reason it is advised that patients be shielded from direct sunlight for a minimum of 4 weeks following therapy.

In the treatment of clinical cases, after the tumor type has been histologically identified and the patient has been thoroughly screened for metastatic disease or other concurrent systemic disorders, HPD is injected intravenously at a rate of 5 mg/kg. Seventy-two hours after drug injection the tumor mass is illuminated with ordinary red light. (72 hours is the minimum time required for adequate clearance of HPD from normal tissues.) Red light is used because it penetrates living tissue most effectively. The light source is an argon laser coupled with a dye laser pumped with rhodamine B dye which produces a spectral output centered at 635 nm. HPD within the tissues absorbs light in a wavelength range of 620-640 nm. The light is delivered directly to the tumor mass

"The Older Cat"

Office Handouts Available

At the recommendation and request of several practitioners, we are making available in bulk our September 1982 newsletter for cat fanciers, which was devoted to the medical needs of the older cat.

An excellent client information handout, the newsletter gives an overview of nutrition, kidney failure, tumors, digestive disorders, oral problems, heart and circulatory disorders, diabetes mellitus, and arthritis, all in relation to the geriatric cat. Dr. Fredric W. Scott explains the importance of regular vaccinations throughout the cat's lifetime. Dr. Sandy Baldwin explains feline thyroid disease and thyroidectomy for the lay reader.

This special issue is available to veterinarians for a donation of $15 per 100. This is a tax-deductible donation and thus cannot be billed. To acquire copies of the newsletter for your office, send your request and donation to Cornell Feline Health Center Reprints, N.Y.S. College of Veterinary Medicine, Ithaca, NY 14853.

via fiber optics passing through an 18-gauge hypodermic needle embedded within the tumor. The tumor is illuminated for 20-30 minutes at a power output of 200-500 milliwatts/fiber.

HPD within the tumor absorbs light energy, then releases it, converting tissue molecular oxygen to singlet oxygen. Singlet oxygen is extremely unstable and immmediately reacts with cell components, particularly cell membrane, causing oxidation of those components and death of the cell. For a period of 1-4 weeks following treatment the tumor mass undergoes necrosis and sloughs, and then is replaced by normal tissue. If regrowth occurs, a second treatment may be indicated.

Phototherapy has been shown to be an effective form of therapy for certain types of discreet solid malignant tumors. Due to these limitations it is not an effective form of treatment for feline leukemia virus-related neoplasms which generally present as diffuse, diffusely infiltrative, or highly multicentric conditions. Phototherapy has been very successful in many other forms of malignant neoplasia which can affect the cat. With the exception of osteosarcoma of the long bones, virtually all tumor types treated have shown some degree of positive response. Osteosarcomas of the bones of the head have responded extremely well, as have mast cell tumors, malignant melanomas, fibrosarcomas and some squamous cell carcinomas. An overall rate of total remission of 50% has been achieved.

Phototherapy is a very recent development in cancer therapy and is still in the experimental phases. It is difficult to say at this time what place it may eventually assume in veterinary practice but preliminary positive results show a potential which must be thoroughly examined. Phototherapy should provide a successful mode of therapy for some neoplastic conditions which are not completely responsive to presently available conventional cancer treatments.

Inquiries regarding the application of phototherapy to veterinary medicine may be directed to:

Dr. Richard E. Thoma
Town and Country Animal Clinic
3095 Genesee St.
Cheektowaga, NY 14225
(716) 896-2424

(A detailed explanation of phototherapy by Dr. Thoma will appear in Current Veterinary Therapy VIII, Robert W. Kirk, ed., W.B. Saunders Co., Philadelphia, 1983.)

John S. Clauss, a 1982 graduate of Cornell, practices small animal medicine in Kenmore, N.Y. The information in this article was presented at his Senior Seminar.